

TOXICOLOGICAL PROFILE FOR ALUMINUM

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

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DISCLAIMER

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UPDATE STATEMENT

A Toxicological Profile for Aluminum was released in October 1995. This edition supersedes any previously released draft or final profile.

Toxicological profiles are revised and republished as necessary, but no less than once every three years. For information regarding the update status of previously released profiles, contact ATSDR at:

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FOREWORD

This toxicological profile is prepared in accordance with guidelines* developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The original guidelines were published in the *Federal Register* on April 17, 1987. Each profile will be revised and republished as necessary.

The ATSDR toxicological profile succinctly characterizes the toxicologic and adverse health effects information for the hazardous substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicologic properties. Other pertinent literature is also presented, but is described in less detail than the key studies. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced.

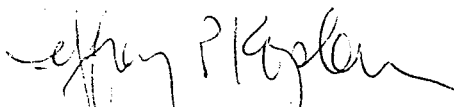
The focus of the profiles is on health and toxicologic information; therefore, each toxicological profile begins with a public health statement that describes, in nontechnical language, a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to protection of public health are identified by ATSDR and EPA.

Each profile includes the following:

- (A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a hazardous substance to ascertain the levels of significant human exposure for the substance and the associated acute, subacute, and chronic health effects;
- (B) A determination of whether adequate information on the health effects of each substance is available or in the process of development to determine levels of exposure that present a significant risk to human health of acute, subacute, and chronic health effects; and
- (C) Where appropriate, identification of toxicologic testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

The principal audiences for the toxicological profiles are health professionals at the Federal, State, and local levels; interested private sector organizations and groups; and members of the public.

This profile reflects ATSDR's assessment of all relevant toxicologic testing and information that has been peer-reviewed. Staff of the Centers for Disease Control and Prevention and other Federal scientists have also reviewed the profile. In addition, this profile has been peer-reviewed by a nongovernmental panel and was made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.



Jeffrey P. Koplan, M.D., M.P.H.

Administrator

Agency for Toxic Substances and
Disease Registry

*Legislative Background

The toxicological profiles are developed in response to the Super-fund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Super-fund). This public law directed ATSDR to prepare toxicological profiles for hazardous substances most commonly found at facilities on the CERCLA National Priorities List and that pose the most significant potential threat to human health, as determined by ATSDR and the EPA. The availability of the revised priority list of 275 hazardous substances *was* announced *in the Federal Register* on November 17, 1997 (62 FR 61332). For prior versions of the list of substances, see *Federal Register* notices dated April 29, 1996 (61 FR 18744); April 17, 1987 (52 FR 12866); October 20, 1988 (53 FR 41280); October 26, 1989 (54 FR 43619); October 17, 1990 (55 FR 42067); October 17, 1991 (56 FR 52166); October 28, 1992 (57 FR 48801); and February 28, 1994 (59 FR 9486). Section 104(i)(3) of CERCLA, as amended, directs the Administrator of ATSDR to prepare a toxicological profile for each substance on the list.

QUICK REFERENCE FOR HEALTH CARE PROVIDERS

Toxicological Profiles are a unique compilation of toxicological information on a given hazardous substance. Each profile reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicologic and epidemiologic information on a substance. Health care providers treating patients potentially exposed to hazardous substances will find the following information helpful for fast answers to often-asked questions.

Primary Chapters/Sections of Interest

Chapter 1: Public Health Statement: The Public Health Statement can be a useful tool for educating patients about possible exposure to a hazardous substance. It explains a substance's relevant toxicologic properties in a nontechnical, question-and-answer format, and it includes a review of the general health effects observed following exposure.

Chapter 2: Health Effects: Specific health effects of a given hazardous compound are reported by *route of exposure*, by *type of health effect* (death, systemic, immunologic, reproductive), and by *length of exposure* (acute, intermediate, and chronic). In addition, both human and animal studies are reported in this section.

NOTE: Not all health effects reported in this section are necessarily observed in the clinical setting. Please refer to the Public Health Statement to identify general health effects observed following exposure.

Pediatrics: Four new sections have been added to each Toxicological Profile to address child health issues:

Section 1.6 How Can (Chemical X) Affect Children?

Section 1.7 How Can Families Reduce the Risk of Exposure to (Chemical X)?

Section 2.6 Children's Susceptibility

Section 5.6 Exposures of Children

Other Sections of Interest:

Section 2.7 Biomarkers of Exposure and Effect

Section 2.10 Methods for Reducing Toxic Effects

ATSDR Information Center

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Fax: 404-639-6359

E-mail: atsdr@cdc.gov

Internet: <http://www.atsdr.cdc.gov>

The following additional material can be ordered through the ATSDR Information Center:

*Case Studies in Environmental Medicine: Taking an Exposure History-*The importance of taking an exposure history and how to conduct one are described, and an example of a thorough exposure history is provided. Other case studies of interest include *Reproductive and Developmental Hazards*; *Skin Lesions and Environmental Exposures*; *Cholinesterase-Inhibiting Pesticide Toxicity*; and numerous chemical-specific case studies.

Managing Hazardous Materials Incidents is a three-volume set of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident. Volumes I and II are planning guides to assist first responders and hospital emergency department personnel in planning for incidents that involve hazardous materials. Volume III---*Medical Management Guidelines for Acute Chemical Exposures*---is a guide for health care professionals treating patients exposed to hazardous materials.

Fact Sheets (ToxFAQs) provide answers to frequently asked questions about toxic substances.

Other Agencies and Organizations

The National Center for Environmental Health (NCEH) focuses on preventing or controlling disease, injury, and disability related to the interactions between people and their environment outside the workplace. *Contact:* NCEH, Mailstop F-29, 4770 Buford Highway, NE, Atlanta, GA 30341- 3724 •Phone: 770-488-7000 •FAX: 770-488-7015.

The National Institute for Occupational Safety and Health (NIOSH) conducts research on occupational diseases and injuries, responds to requests for assistance by investigating problems of health and safety in the workplace, recommends standards to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and trains professionals in occupational safety and health. *Contact:* NIOSH, 200 Independence Avenue, SW, Washington, DC 20201 Phone: 800-356-4674 or NIOSH Technical Information Branch, Robert A. Taft Laboratory, Mailstop C-19, 4676 Columbia Parkway, Cincinnati, OH 45226-1998 •Phone: 800-35-NIOSH.

The National Institute of Environmental Health Sciences (NIEHS) is the principal federal agency for biomedical research on the effects of chemical, physical, and biologic environmental agents on human health and well-being. *Contact:* NIEHS, PO Box 12233, 104 T.W. Alexander Drive, Research Triangle Park, NC 27709 •Phone: 919-541-3212.

Referrals

The Association of Occupational and Environmental Clinics (AOEC) has developed a network of clinics in the United States to provide expertise in occupational and environmental issues. *Contact:* AOEC, 1010 Vermont Avenue, NW, #513, Washington, DC 20005 •Phone: 202-347-4976 •FAX: 202-347-4950 •e-mail: aoec@dgs.dgsys.com •AOEC Clinic Director: <http://occ-envmed.mc.duke.edu/oem/aoec.htm>

The American College of Occupational and Environmental Medicine (ACOEM) is an association of physicians and other health care providers specializing in the field of occupational and environmental medicine. *Contact:* ACOEM, 55 West Seegers Road, Arlington Heights, IL 60005 •Phone: 847-228-6850 •FAX: 847-228-1856.

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THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

- 1 . Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.
- 2 . Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific minimal risk levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.
- 3 . Data Needs Review. The Research Implementation Branch reviews data needs sections to assure consistency across profiles and adherence to instructions in the Guidance.

PEER REVIEW

A peer review panel was assembled for aluminum. The panel consisted of the following members:

- 1 . Dr. Charles Buncher, Director, Division of Epidemiology and Biostatistics, University of Cincinnati College of Medicine, Cincinnati, OH;
- 2 . Dr. Inge Harding-Barlow, Private Consultant, Palo Alto, CA;
- 3 . Dr. Norman Trieff, Professor, University of Texas Medical Branch, Galveston, TX;
- 4 . Dr. Allen Alfrey, Physician, Denver CO; and
- 5 . Dr. Mari Golub, Professor, California Regional Primate Research Center, University of California, Davis CA

These experts collectively have knowledge of aluminum's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(i)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.

CONTENTS

FOREWORD	v
QUICK REFERENCE FOR HEALTH CARE PROVIDERS	vii
CONTRIBUTORS	ix
PEER REVIEW	xi
LIST OF FIGURES	xvii
LIST OF TABLES	xix
1. PUBLIC HEALTH STATEMENT	1
1.1 WHAT IS ALUMINUM?	1
1.2 WHAT HAPPENS TO ALUMINUM WHEN IT ENTERS THE ENVIRONMENT?	2
1.3 HOW MIGHT I BE EXPOSED TO ALUMINUM?	3
1.4 HOW CAN ALUMINUM ENTER AND LEAVE MY BODY?	5
1.5 HOW CAN ALUMINUM AFFECT MY HEALTH?	5
1.6 HOW CAN ALUMINUM AFFECT CHILDREN?	6
1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO ALUMINUM?	7
1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO ALUMINUM?	8
1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?	8
1.10 WHERE CAN I GET MORE INFORMATION?	9
2. HEALTH EFFECTS	11
2.1 INTRODUCTION	11
2.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE	11
2.2.1 Inhalation Exposure	13
2.2.1.1 Death	13
2.2.1.2 Systemic Effects	14
2.2.1.3 Immunological and Lymphoreticular Effects	28
2.2.1.4 Neurological Effects	29
2.2.1.5 Reproductive Effects	30
2.2.1.6 Developmental Effects	31
2.2.1.7 Genotoxic Effects	31
2.2.1.8 Cancer	31
2.2.2 Oral Exposure	33
2.2.2.1 Death	50
2.2.2.2 Systemic Effects	51
2.2.2.3 Immunological and Lymphoreticular Effects	61
2.2.2.4 Neurological Effects	62
2.2.2.5 Reproductive Effects	70
2.2.2.6 Developmental Effects	72
2.2.2.7 Genotoxic Effects	76

2.2.2.8	Cancer	77
2.2.3	Dermal Exposure	77
2.2.3.1	Death	77
2.2.3.2	Systemic Effects	78
2.2.3.3	Immunological and Lymphoreticular Effects	78
2.2.3.4	Neurological Effects	82
2.2.3.5	Reproductive Effects	82
2.2.3.6	Developmental Effects	82
2.2.3.7	Genotoxic Effects	82
2.2.3.8	Cancer	82
2.3	TOXICOKINETICS	83
2.3.1	Absorption	84
2.3.1.1	Inhalation Exposure	84
2.3.1.2	Oral Exposure	85
2.3.1.3	Dermal Exposure	88
2.3.1.4	Other Routes of Exposure	89
2.3.2	Distribution	89
2.3.2.1	Inhalation Exposure	90
2.3.2.2	Oral Exposure	90
2.3.2.3	Dermal Exposure	93
2.3.2.4	Other Routes of Exposure	93
2.3.3	Metabolism	95
2.3.4	Elimination and Excretion	95
2.3.4.1	Inhalation Exposure	95
2.3.4.2	Oral Exposure	96
2.3.4.3	Dermal Exposure	97
2.3.4.4	Other Routes of Exposure	97
2.3.5	Physiologically Based Pharmacokinetic (PBPK)/Pharmacodynamic (PD) Models	97
2.4	MECHANISMS OF ACTION	99
2.4.1	Pharmacokinetic Mechanisms	99
2.4.2	Mechanisms of Toxicity	102
2.4.3	Animal-to-Human Extrapolations	105
2.5	RELEVANCE TO PUBLIC HEALTH	106
2.6	CHILDREN'S SUSCEPTIBILITY	126
2.7	BIOMARKERS OF EXPOSURE AND EFFECT	131
2.7.1	Biomarkers Used to Identify or Quantify Exposure to Aluminum	132
2.7.2	Biomarkers Used to Characterize Effects Caused by Aluminum	132
2.8	INTERACTIONS WITH OTHER CHEMICALS	132
2.9	POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE	134
2.10	METHODS FOR REDUCING TOXIC EFFECTS	134
2.10.1	Reducing Peak Absorption Following Exposure	135
2.10.2	Reducing Body Burden	135
2.10.3	Interfering with the Mechanism of Action for Toxic Effects	135
2.11	ADEQUACY OF THE DATABASE	135
2.11.1	Existing Information on Health Effects of Aluminum	136
2.11.2	Identification of Data Needs: Children's Susceptibility	138
2.11.3	Identification of Data Needs	138
2.11.4	Ongoing Studies	147

3. CHEMICAL AND PHYSICAL INFORMATION	151
3.1 CHEMICAL IDENTITY	151
3.2 PHYSICAL AND CHEMICAL PROPERTIES	151
4. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL	173
4.1 PRODUCTION	173
4.2 IMPORT/EXPORT	177
4.3 USE	179
4.4 DISPOSAL	181
5. POTENTIAL FOR HUMAN EXPOSURE	183
5.1 OVERVIEW	183
5.2 RELEASES TO THE ENVIRONMENT	188
5.2.1 Air	188
5.2.2 Water	190
5.2.3 Soil	192
5.3 ENVIRONMENTAL FATE	192
5.3.1 Transport and Partitioning	192
5.3.2 Transformation and Degradation	198
5.3.2.1 Air	198
5.3.2.2 Water	198
5.3.2.3 Sediment and Soil	200
5.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT	200
5.4.1 Air	200
5.4.2 Water	201
5.4.3 Sediment and Soil	205
5.4.4 Other Environmental Media	206
5.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE	217
5.6 EXPOSURES OF CHILDREN	224
5.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES	229
5.8 ADEQUACY OF THE DATABASE	230
5.8.1 Identification of Data Needs	231
5.8.2 Ongoing Studies	234
6. ANALYTICAL METHODS	241
6.1 BIOLOGICAL SAMPLES	241
6.2 ENVIRONMENTAL SAMPLES	247
6.3 ADEQUACY OF THE DATABASE	250
6.3.1 Identification of Data Needs	250
6.3.2 Ongoing Studies	252
7. REGULATIONS AND ADVISORIES	253
8. REFERENCES	271
9. GLOSSARY	347

APPENDICES

A.	ATSDR MINIMAL RISK LEVEL AND WORKSHEETS	A-1
B.	USER'S GUIDE	B-1
C.	ACRONYMS, ABBREVIATIONS, AND SYMBOLS	C-1

LIST OF FIGURES

2-1	Levels of Significant Exposure to Aluminum - Inhalation	19
2-2	Levels of Significant Exposure to Aluminum - Oral	45
2-3	Conceptional Representation of a Physiologically Based Pharmacokinetic (PBPK) Model for a Hypothetical Chemical Substance	100
2-4	Existing Information on Health Effects of Aluminum and Compounds	137
5-1	Frequency of NPL Sites with Aluminum Contamination	189

LIST OF TABLES

2-1	Levels of Significant Exposure to Aluminum and Compounds - Inhalation	15
2-2	Levels of Significant Exposure to Aluminum and Compounds - Oral	35
2-3	Levels of Significant Exposure to Aluminum and Compounds - Dermal	79
2-4	Genotoxicity of Aluminum <i>In Vitro</i>	127
2-5	Ongoing Studies for Aluminum Toxicity	148
3-1	Chemical Identity of Aluminum and Compounds	152
3-2	Physical and Chemical Properties of Aluminum and Compounds	162
4-1	Facilities That Manufacture or Process Aluminum and Its Compounds	176
4-2	Facilities That Manufacture or Process Aluminum Oxide	178
5-1	Releases to the Environment from Facilities That Manufacture or Process Aluminum and Its Compounds	185
5-2	Releases to the Environment from Facilities That Manufacture or Process Aluminum Oxide	187
5-3	Aluminum Concentrations Detected in Drinking Water in Various Regions of the United States	203
5-4	Estimated Aluminum Concentrations of Selected Foods	207
5-5	Comparison of Aluminum Levels ($\mu\text{g/L}$) in Breast Milk, Humanized Infant Formulae, and in Special Purpose Infant Formulae	213
5-6	Concentrations of Aluminum (ppm wet weight) in Foods Before and After Cooking in Aluminum and Stainless Steel Cookware	214
5-7	Aluminum-containing Non-prescription Drugs and Sucralfate	216
5-8	Estimated Number of Workers Potentially Exposed to Aluminum and Its Compounds in the Workplace	223
5-9	Dietary Intakes of Aluminum in Children	226
5-10	Major Sources of Aluminum in Food by Age-Sex Group	227
5-11	Ongoing Studies on Aluminum	235

6-1	Analytical Methods for Determining Aluminum in Biological Materials	242
6-2	Analytical Methods for Determining Aluminum in Environmental Samples	248
7-1	Regulations and Guidelines Applicable to Aluminum	254